

TC74VCXR2245FT, TC74VCXR2245FK, TC74VCXR2245FTG**Low-Voltage Octal Bus Transceiver with 3.6-V Tolerant Inputs and Outputs**

The TC74VCXR2245 is a high-performance CMOS octal bus transceiver. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

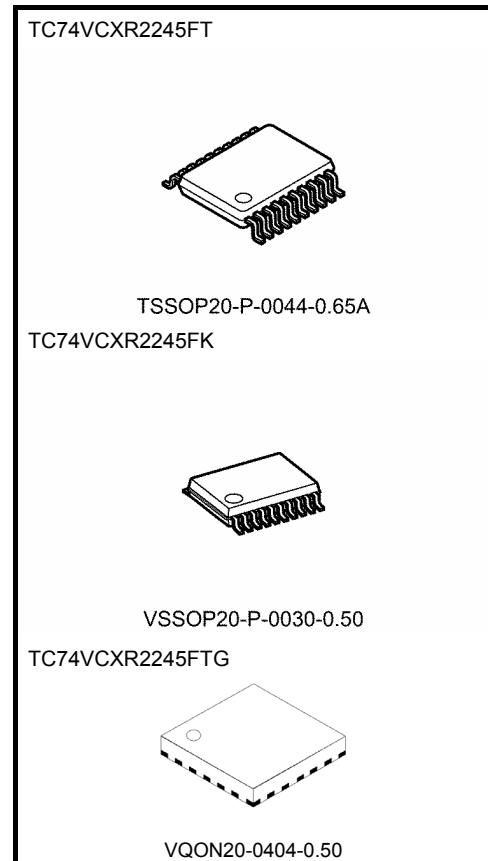
It is also designed with overvoltage tolerant inputs and outputs up to 3.6 V.

The direction of data transmission is determined by the level of the DIR inputs. The OE inputs can be used to disable the device so that the busses are effectively isolated. The 26- Ω series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.

Features (Note 1)

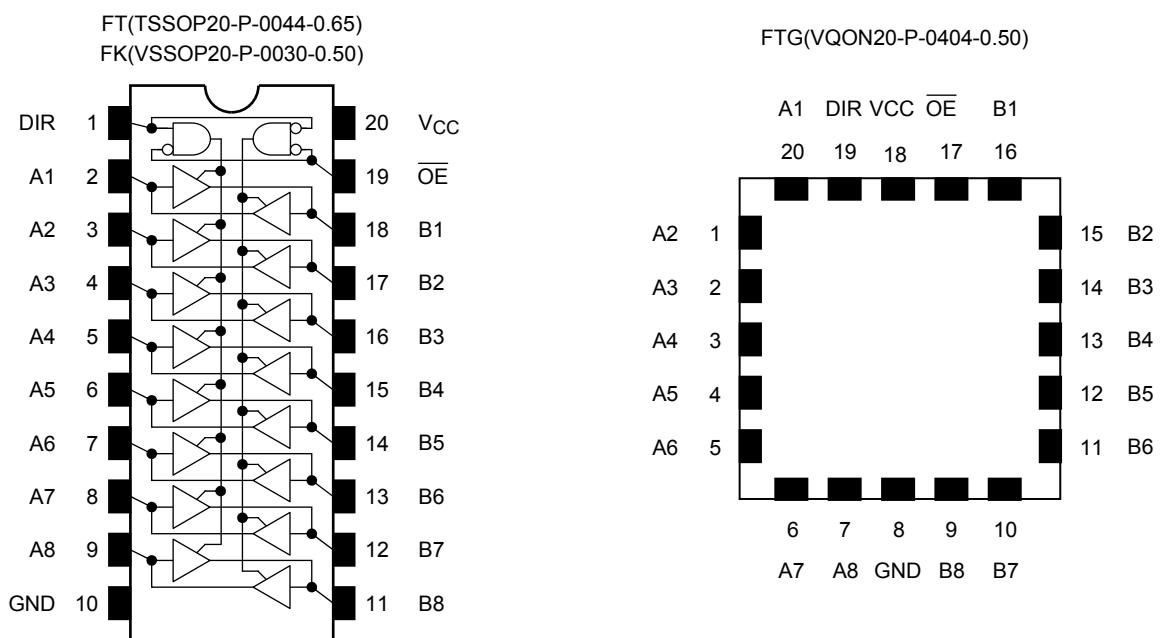
- 26- Ω series resistors on outputs
- Low-voltage operation: $V_{CC} = 1.8$ to 3.6 V
- High-speed operation: $t_{pd} = 4.4$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
: $t_{pd} = 5.6$ ns max) ($V_{CC} = 2.3$ to 2.7 V)
: $t_{pd} = 9.8$ ns (max) ($V_{CC} = 1.8$ V)
- Output current: $I_{OH}/I_{OL} = \pm 12$ mA (min) ($V_{CC} = 3.0$ V)
: $I_{OH}/I_{OL} = \pm 8$ mA (min) ($V_{CC} = 2.3$ V)
: $I_{OH}/I_{OL} = \pm 4$ mA (min) ($V_{CC} = 1.8$ V)
- Latch-up performance: -300 mA
- ESD performance: Machine model $\geq \pm 200$ V
Human body model $\geq \pm 2000$ V
- Package: TSSOP
VSSOP (US)
VQON
- 3.6-V tolerant function and power-down protection provided on all inputs and outputs



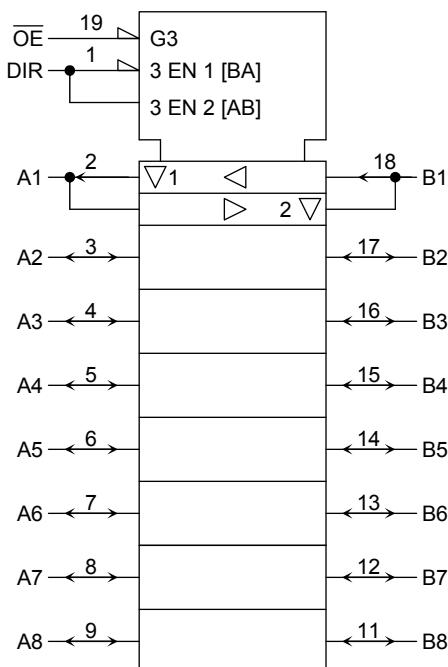
Weight	
TSSOP20-P-0044-0.65A	: 0.08 g (typ.)
VSSOP20-P-0030-0.50	: 0.03 g (typ.)
VQON20-P-0404-0.50	: 0.0145g (typ.)

Note 1: When mounting VQON package, the type of recommended flux is RA or RMA.

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs		Outputs	Function	
			A-Bus	B-Bus
L	L	A = B	OUTPUT	INPUT
L	H	B = A	INPUT	OUTPUT
H	X	Z		Z

X: Don't care

Z: High impedance

Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V _{CC}	−0.5 to 4.6	V
DC input voltage (DIR, \overline{OE})	V _{IN}	−0.5 to 4.6	V
DC bus I/O voltage	V _{I/O}	−0.5 to 4.6 (Note 2)	V
		−0.5 to V _{CC} + 0.5 (Note 3)	
Input diode current	I _{IK}	−50	mA
Output diode current	I _{OK}	±50 (Note 4)	mA
DC output current	I _{OUT}	±50	mA
Power dissipation	P _D	180	mW
DC V _{CC} /ground current	I _{CC} /I _{GND}	±100	mA
Storage temperature	T _{stg}	−65 to 150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 2: OFF state

Note 3: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 4: V_{OUT} < GND, V_{OUT} > V_{CC}

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V _{CC}	1.8 to 3.6	V
		1.2 to 3.6 (Note 2)	
Input voltage (DIR, \overline{OE})	V _{IN}	−0.3 to 3.6	V
Bus I/O voltage	V _{I/O}	0 to 3.6 (Note 3)	V
		0 to V _{CC} (Note 4)	
Output current	I _{OH} /I _{OL}	±12 (Note 5)	mA
		±8 (Note 6)	
		±4 (Note 7)	
Operating temperature	T _{opr}	−40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 8)	ns/V

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either V_{CC} or GND. Please connect both bus inputs and the bus outputs with V_{CC} or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 2: Data retention only

Note 3: OFF state

Note 4: High or low state

Note 5: V_{CC} = 3.0 to 3.6 V

Note 6: V_{CC} = 2.3 to 2.7 V

Note 7: V_{CC} = 1.8 V

Note 8: V_{IN} = 0.8 to 2.0 V, V_{CC} = 3.0 V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C, 2.7 V < V_{CC} ≤ 3.6 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit	
Input voltage	H-level		—						
	L-level	V _{IL}	—		2.7 to 3.6	—	0.8	V	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.7 to 3.6	V _{CC} - 0.2	—		
				I _{OH} = -6 mA	2.7	2.2	—		
				I _{OH} = -8 mA	3.0	2.4	—		
				I _{OH} = -12 mA	3.0	2.2	—		
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.7 to 3.6	—	0.2		
				I _{OL} = 6 mA	2.7	—	0.4		
				I _{OL} = 8 mA	3.0	—	0.55		
				I _{OL} = 12 mA	3.0	—	0.8		
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		2.7 to 3.6	—	±5.0	μA	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V		2.7 to 3.6	—	±10.0	μA	
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA	
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.7 to 3.6	—	20.0	μA	
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} - 0.6 V (per input)		2.7 to 3.6	—	750		

DC Characteristics (Ta = -40 to 85°C, 2.3 V ≤ V_{CC} ≤ 2.7 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit	
Input voltage	H-level		—						
	L-level	V _{IL}	—		2.3 to 2.7	—	0.7	V	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.3 to 2.7	V _{CC} - 0.2	—		
				I _{OH} = -4 mA	2.3	2.0	—		
				I _{OH} = -6 mA	2.3	1.8	—		
				I _{OH} = -8 mA	2.3	1.7	—		
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3 to 2.7	—	0.2		
				I _{OL} = 6 mA	2.3	—	0.4		
				I _{OL} = 8 mA	2.3	—	0.6		
				I _{OL} = 12 mA	2.3 to 2.7	—	0.8		
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		2.3 to 2.7	—	±5.0	μA	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V		2.3 to 2.7	—	±10.0	μA	
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA	
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.3 to 2.7	—	20.0	μA	

DC Characteristics (Ta = -40 to 85°C, 1.8 V ≤ V_{CC} < 2.3 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit	
Input voltage	H-level	V _{IH}	—			1.8 to 2.3	0.7 × V _{CC}	—	
	L-level	V _{IL}	—			1.8 to 2.3	—	0.2 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	1.8	V _{CC} - 0.2	—	V	
				I _{OH} = -4 mA	1.8	1.4	—		
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.8	—	0.2		
				I _{OL} = 4 mA	1.8	—	0.3		
Input leakage current		I _{IN}	V _{IN} = 0 to 3.6 V		1.8	—	±5.0	μA	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V		1.8	—	±10.0	μA	
Power-off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0 to 3.6 V		0	—	10.0	μA	
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		1.8	—	20.0	μA	
					1.8	—	±20.0		

AC Characteristics (Ta = -40 to 85°C, input: t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω) (Note 1)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit		
Propagation delay time		t _{pLH} t _{pHL}	Figure 1, Figure 2			1.8	1.5	9.8	ns	
						2.5 ± 0.2	0.8	5.6		
						3.3 ± 0.3	0.6	4.4		
3-state output enable time		t _{pZL} t _{pZH}	Figure 1, Figure 3			1.8	1.5	9.8	ns	
						2.5 ± 0.2	0.8	6.6		
						3.3 ± 0.3	0.6	5.0		
3-state output disable time		t _{pLZ} t _{pHZ}	Figure 1, Figure 3			1.8	1.5	8.5	ns	
						2.5 ± 0.2	0.8	4.7		
						3.3 ± 0.3	0.6	4.2		
Output to output skew		t _{osLH} t _{osHL}	(Note 2)			1.8	—	0.5	ns	
						2.5 ± 0.2	—	0.5		
						3.3 ± 0.3	—	0.5		

Note 1: For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Note 2: Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHm} - t_{pHn}|)$$

Dynamic Switching Characteristics ($T_a = 25^\circ\text{C}$, input: $t_r = t_f = 2.0 \text{ ns}$, $C_L = 30 \text{ pF}$)

Characteristics	Symbol	Test Condition	$V_{CC} (\text{V})$	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	1.8	0.15
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	2.5	0.25
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	3.3	0.35
Quiet output minimum dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	1.8	-0.15
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	2.5	-0.25
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	3.3	-0.35
Quiet output minimum dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	1.8	1.55
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	2.5	2.05
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$	(Note)	3.3	2.65

Note: Parameter guaranteed by design.

Capacitive Characteristics ($T_a = 25^\circ\text{C}$)

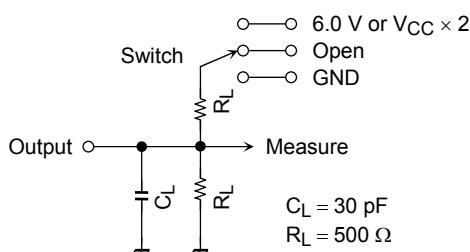
Characteristics	Symbol	Test Condition	$V_{CC} (\text{V})$	Typ.	Unit	
Input capacitance	C_{IN}	DIR, \overline{OE}	1.8, 2.5, 3.3	6	pF	
Bus I/O capacitance	$C_{I/O}$	An, Bn	1.8, 2.5, 3.3	7	pF	
Power dissipation capacitance	C_{PD}	$f_{IN} = 10 \text{ MHz}$	(Note)	1.8, 2.5, 3.3	20	pF

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC} (\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

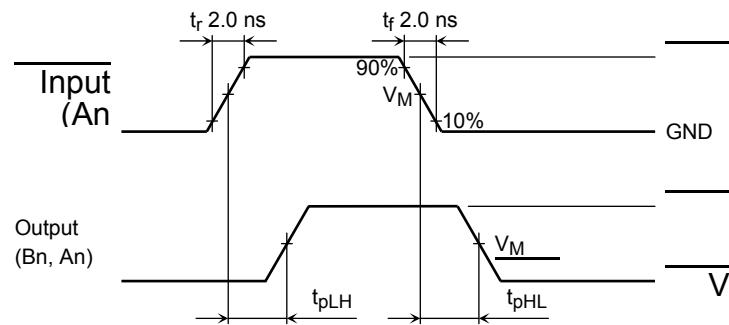
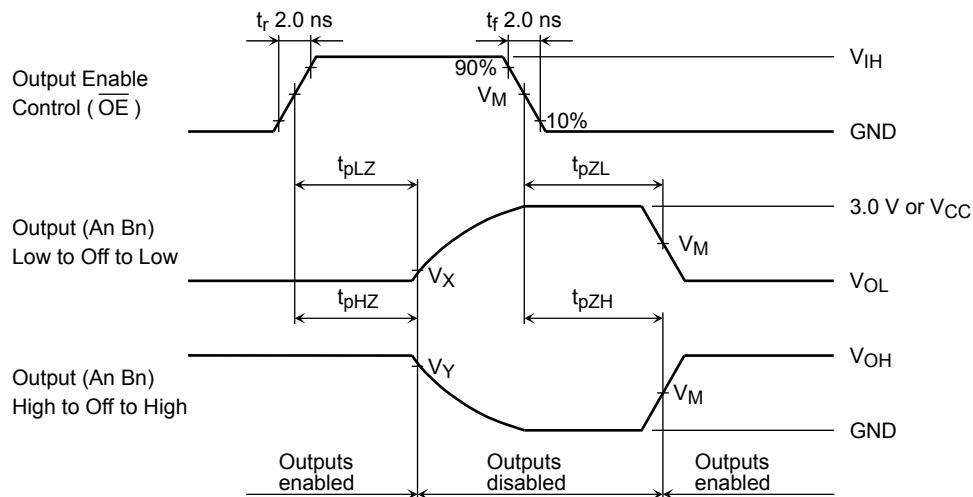
AC Test Circuit



Parameter	Switch
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V @ $V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} \times 2$ @ $V_{CC} = 2.5 \pm 0.2 \text{ V}$ @ $V_{CC} = 1.8 \text{ V}$
t_{pHZ}, t_{pZH}	GND

Figure 1

AC Waveform

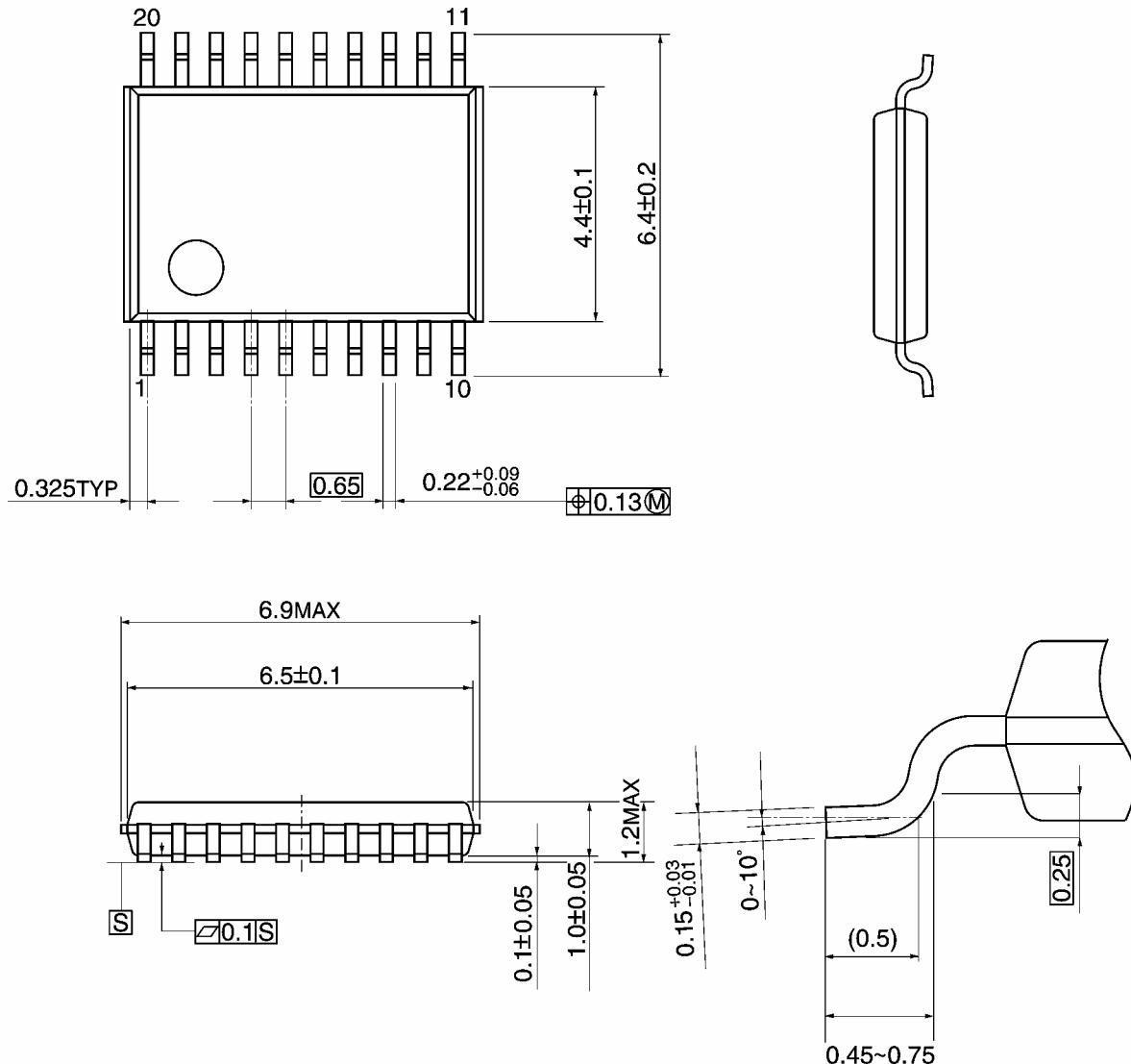
Figure 2 t_{pLH} , t_{pHL} Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3$ V	$V_{OL} + 0.15$ V	$V_{OL} + 0.15$ V
V_Y	$V_{OH} - 0.3$ V	$V_{OH} - 0.15$ V	$V_{OH} - 0.15$ V

Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm

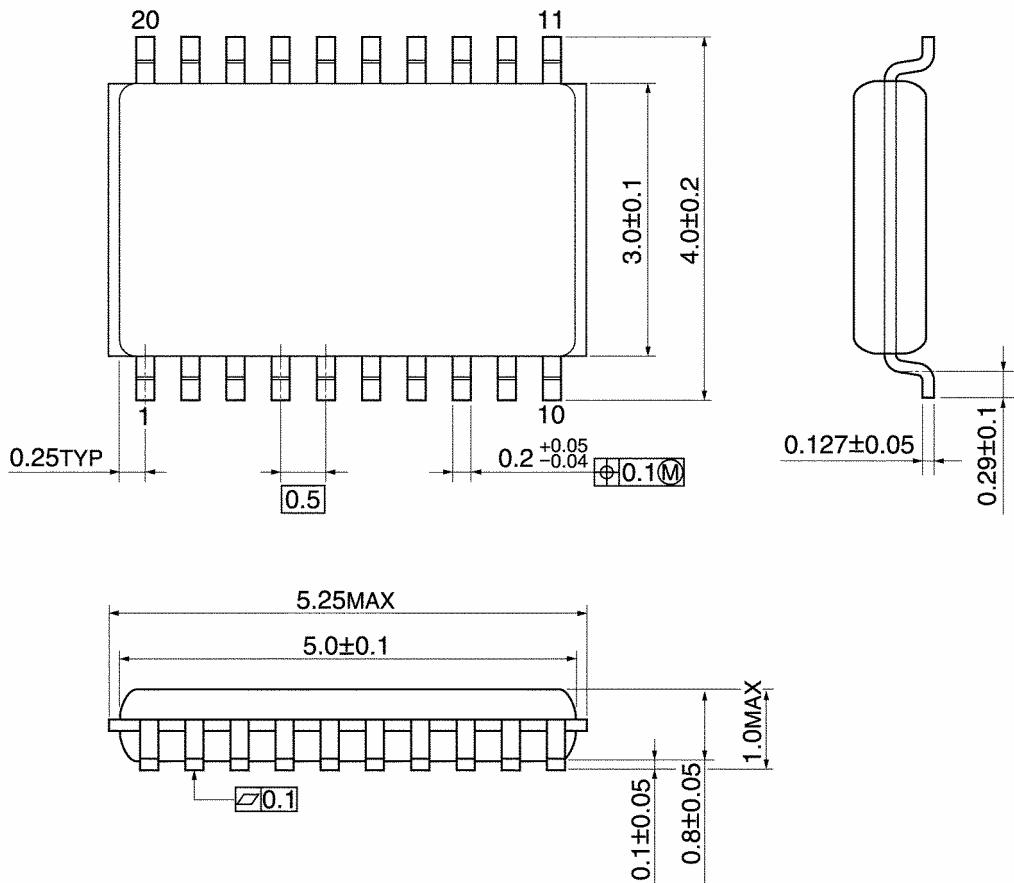


Weight: 0.08 g (typ.)

Package Dimensions

VSSOP20-P-0030-0.50

Unit: mm

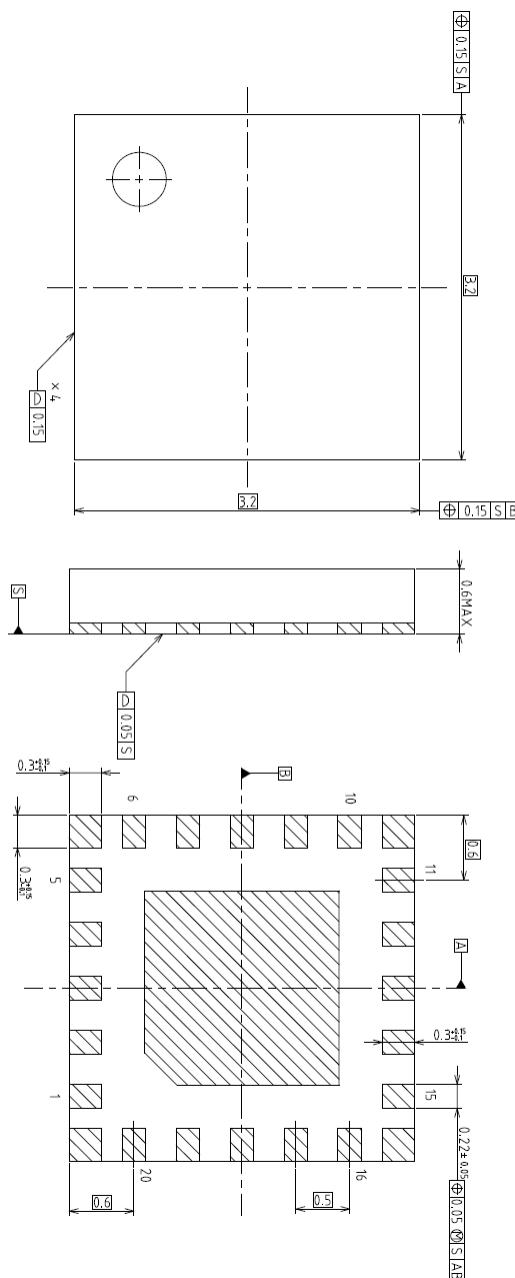


Weight: 0.03 g (typ.)

Package Dimensions

VQON20-P-0404-0.50

Unit: mm



Weight: 0.0145 g (typ.)

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20070701-EN

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